Mathematics Component

of the Program of Studies
for Elementary Schools

A DRAFT FOR REVIEW AND RESPONSE

January 1991

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MATHEMATICS

A. PROGRAM RATIONALE AND PHILOSOPHY

Mathematics plays an important role in all aspects of human endeavour. Whether one is buying at the market or designing wallpaper with a regular pattern, mathematics is necessary to understand the world and function in it. Learning mathematics should help students realize that mathematics is a common human activity and that it is essential in preparing them for the work world.

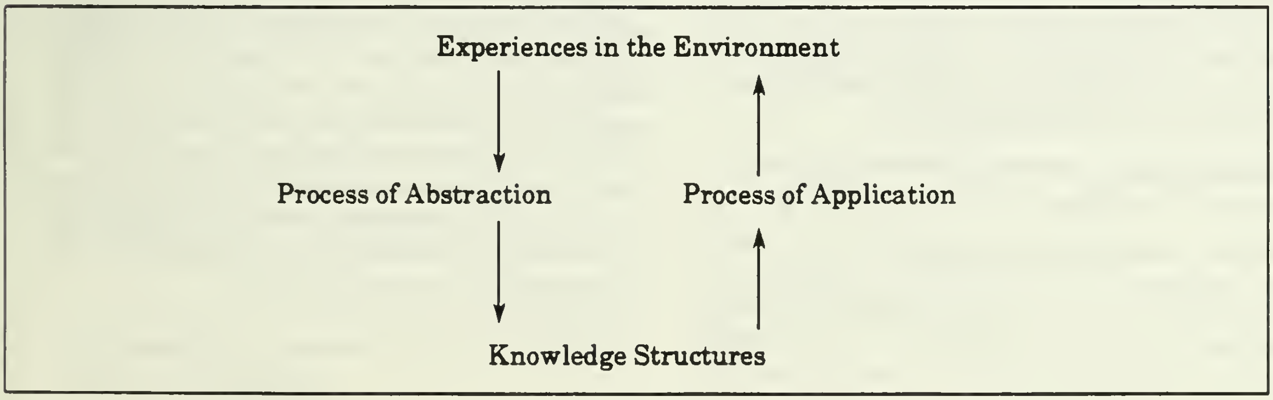
The study of mathematics leads to a better understanding and appreciation of the quantitative and geometric nature of the concrete world and to the development of the knowledge, skills and positive attitudes necessary for decision making in personal living. Mathematics involves both mental and physical activity. Building knowledge structures is a mental activity that relates directly to manipulating objects, constructing models and drawing diagrams.

Students in any classroom have different learning needs and abilities. Therefore, students develop their mathematical understanding at different rates and in different ways. All students learn more when they receive mathematics education appropriate to their needs and abilities.

The mathematics program is based on a set of fundamental principles. These principles outline the elements essential to students' understanding of mathematics.

The learner and teacher together construct mathematical knowledge by abstracting concepts on the basis of what is learned from their experiences in the world around them. These concepts are then applied to other experiences.

The following diagram illustrates the cycle of mathematical activity that is used in building and applying mathematical concepts.



The process of abstraction involves building knowledge structures by using the senses to obtain the necessary information from experiences. This includes combining the knowledge gained from past and present experiences.

The process of application involves thinking about the concepts learned from these experiences in the environment and recognizing their relevance and usefulness in solving problems related to other experiences in the environment.

The mathematics program should motivate students to explore concepts that are appropriate to their level of cognitive development. This fosters positive attitudes toward mathematics and learning.

Positive attitudes are fostered when students understand the mathematical concepts by being actively involved in meaningful learning experiences that are appropriate to their abilities. Therefore, assessment must be an integral part of the learning process. Tailoring instruction to meet individual needs promotes the students' understanding of mathematics and nurtures the confidence necessary for taking risks, accepting challenges and making decisions.

Mathematics should be learned in a problem-solving context.

Using mathematics to solve problems taken from daily life helps students understand concepts and realize the importance of mathematics. Teaching a concept begins with a problem situation that contains the key aspects of the concept. As students solve the problem they develop an understanding of the concept. Students should be encouraged to work with others on problems and to persevere in finding a variety of solutions over a period of time. This problem-based approach helps students to develop the ability to reason and to apply mathematics in problem situations.

Communication through active learning is essential for conceptual understanding.

Learning situations must be provided in which the students are actively engaged in constructing their own knowledge from first-hand experiences in the real world. The use of concrete representations of mathematical concepts is a necessary step in understanding abstractions. Conceptual understanding requires that the students use manipulatives (concrete mode), diagrams (pictorial mode), and spoken and written symbols (symbolic mode) to represent the concepts and translate from one mode of representation to another. Representing, by using the different modes, actively involves students in communicating and building mathematical ideas.

Language plays a major role in developing students' understanding of mathematics. Students should have the opportunity to explain and defend their ideas orally and in writing. The extension of language to include mathematical signs, symbols and terms, must follow immediately from first-hand experience and become an integral part of the concrete and pictorial modes of representing that experience.

Mathematical connections are required for understanding mathematics.

The students should be able to form the following mathematical connections:

- the relationship among the concrete, pictorial and symbolic modes of representation (i.e., connecting concepts with symbols)
- the relationships among the various topics in mathematics
- the relevance of mathematics in real-life situations
- the relationship of mathematics with other curriculum areas.

Technology is changing mathematics and its use.

Calculators and computers should be used where appropriate. The use of technology results in a substantial change of emphasis. There is an increased emphasis on problem solving and on understanding the processes of mathematics, particularly estimation activities. As a result, focus is placed on understanding simple pencil-and-paper operations. Also, facility with one-digit number facts must be maintained because these skills are necessary for estimating activities. Estimation is crucial in determining the reasonableness of problem solutions obtained by using calculators and computers.

B. GENERAL LEARNER EXPECTATION

The following is the General Learner Expectation for the Mathematics Program of Studies:

Students will demonstrate understanding and appreciation of mathematical concepts, relationships and procedures as they explore, communicate and construct meaning from relevant problem-solving experiences.

The General Learner Expectation (GLE) provides the focus for students' mathematics learning in the elementary years. It encompasses the following critical dimensions of students' mathematics learning:

- **Students are expected to be actively involved in developing an understanding of mathematics.**

  Understanding mathematics requires that the students discover or create knowledge in the course of some activity having a purpose. These activities evolve from problem situations that have meaning to students and help them to appreciate the many applications of mathematics.

  Students should demonstrate an understanding of problem solving as it applies to numeration, operations and properties, measurement, geometry and data management.

- **Students are expected to develop increasing confidence in their abilities to use mathematics.**

  As students develop an understanding of mathematical concepts, it is expected that they will develop:

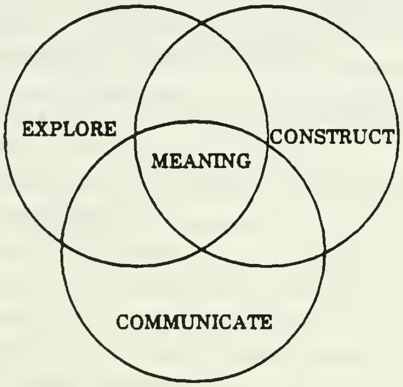
  a. a sense of accomplishment and success with mathematics
  b. a positive attitude toward mathematics
  c. a positive attitude toward learning
  d. a willingness to take risks.

- **Students are expected to develop increasing competence in their abilities to use mathematics.**

  As students progress through the elementary school they must grow in their abilities to apply mathematics in solving problems they might encounter in the real world. The Specific Learner Expectations demonstrate the continuum of growth in students' understanding of mathematics. This spiral nature of mathematics learning emphasizes the importance of building the knowledge of new concepts on a solid foundation of understanding prerequisite concepts. It is important that students not only understand the sequential nature of mathematical growth but also the interrelationship among the mathematical topics.

- **Students are expected to construct meaning in mathematics at different rates and in different ways as they explore new ideas and experiences in the real world and as they communicate with one another.**

  The relationship among exploring, communicating and constructing meaning is shown by the following model:



a. As students **explore** new ideas and experiences in the real world, emphasis is placed on the role curiosity and inquiry can play in learning. It is expected that students will investigate mathematical situations with manipulatives and pictorial representations for the purpose of abstracting specific concepts in symbolic form.

b. As students **communicate** they can clarify their thinking and sharpen their understandings. It is expected that students will use manipulatives (concrete mode), diagrams (pictorial mode), and spoken and written symbols (symbolic mode) to represent concepts and procedures and translate from one mode of representation to another.

c. As students **construct** meaning in mathematics it is essential that they actively explore new concepts by building on their previous knowledge gained from real-world experiences. It is also expected that they communicate this meaning by interrelating the concrete, pictorial and symbolic modes of learning. Constructing meaning in mathematics includes the development of cognitive processes such as locating and relating objects in space, making correspondences, classifying, ordering, iterating (the repetitive use of a unit), and reasoning.

- **Students are expected to apply their knowledge of mathematics in solving new problems. They should identify and carry out appropriate solution procedures and make judgments concerning the reasonableness of solutions.**

  As students construct meaning in mathematics by means of exploring and communicating it is expected that they can then apply the mathematics learned in solving real-world problems. It is essential that students understand mathematics in order for them to use this knowledge in new situations as a problem-solving tool.

- **Students are expected to use technology, where appropriate.**

  Students are expected to use technology such as the calculator, computer and others as an efficient means of developing concepts, exploring relationships and patterns, organizing and displaying data, and carrying out procedures to obtain solutions. They must demonstrate mastery of one-digit number facts so that they are able to estimate. Facility in estimation is crucial in determining the reasonableness of answers obtained by using the calculator and computer.

- **Students are expected to develop psychomotor skills as they explore, communicate and construct meaning in mathematics.**

  Psychomotor skills require a level of proficiency in hand-eye coordination. This is developed through:

  a. manipulation of objects
  b. construction of spatial figures
  c. drawing diagrams
  d. writing symbols.

C. SPECIFIC LEARNER EXPECTATIONS

STRUCTURE OF THE PROGRAM

Specific Learner Expectations are statements about the development of mathematical understandings across the levels from ECS to Grade 6 for each of the five strands:

- numeration
- operations and properties
- measurement
- geometry
- data management.

The problem-solving objectives are outlined for each level and these objectives are to be achieved by solving problems related to the concepts within the strands.

The sequence of learnings approximate the developmental sequence in children. However, the sequence may vary from student to student. The method and sequence of presentation may be modified to meet the needs of individual students.

The strands have been separated for purposes of description but may well be integrated during instruction and learning. The students should understand the connections among the strands and the relationships between mathematics and other curriculum areas.

The spiral nature of the mathematics program requires that students build their understanding of concepts on the basis of what they have already learned. As a result, the concepts taught at a previous grade are either maintained or extended in subsequent grades. The new or extended concepts for each grade are printed in bold type.

For each strand, the letter beside each number refers to a specific objective that spirals through the grades. For example, the letter L in the numeration strand refers to understanding the meaning of fractions. The progressive development of this objective is seen by referring to the objective labelled "L" in the numeration strand for each of the levels for ECS to Grade 6.

The Specific Learner Expectations indicate that the learning process consists of two parts. It begins with constructing knowledge structures from experiences in the environment. This consists of using manipulatives and diagrams in a problem-solving setting to develop an understanding of concepts. These concepts are then connected with the appropriate spoken and written symbols. The second part of the learning process applies the knowledge learned to new problem situations. This includes demonstrating understanding of spoken and written symbols by using manipulatives and diagrams.

SCOPE OF THE PROGRAM

Problem Solving

The most important goal of mathematics instruction is the development of students' ability to solve problems. The emphasis in problem solving is the acquisition and application of many different skills and types of strategies. Students should be able to apply these strategies to a variety of problem situations where the solutions are unknown and the means to the solution are not immediately evident.

The skills, strategies and attitudes associated with problem solving should be integrated into the rest of the program and should become part of the teaching philosophy. Specific skills and strategies for each of the problem-solving stages are outlined for each grade level.

In making problem solving the focus of school mathematics, three aspects of problem solving should be developed by the students:

- learning about how to solve problems
- learning through problem solving
- applying the concepts learned to new problem situations.

Students learn about how to solve problems when they can use the stages in the problem-solving process:

- understanding the problem
- developing a plan
- carrying out a plan
- looking back.

They learn skills associated with each stage and understand a variety of strategies from which they can choose in developing and carrying out their problem-solving plans.

Students learn through problem solving when they learn mathematics topics by beginning with a real-world problem that contains the key aspects of the topic. The learning of mathematics in this way moves from the concrete (the real-world problem that exemplifies a mathematical concept or procedure) to the abstract (knowledge structures that include symbolic representations of the concept or procedure).

In developing the third aspect of problem solving, the students apply the mathematical concepts and procedures that they have learned to new problem situations. This process of application moves from the abstract to the concrete, that is, the students use the knowledge structures (abstract) associated with mathematical concepts or procedures to interpret and solve real-world problem situations (concrete).

Numeration

The numeration strand focuses on developing an understanding of patterns, place value, numbers (whole, decimal and fraction), number relationships (comparing, ordering and rounding) and estimation of quantity. It is basic to all of the other strands.

Operations and Properties

The operations and properties strand focuses on developing understanding of addition, subtraction, multiplication and division of whole numbers and decimals. Emphasis is placed on using a variety of methods to solve problems, including estimation, mental calculation, algorithms and the calculator or computer. This results in de-emphasizing time-consuming pencil-and-paper calculations.

Students must know the one-digit number facts so that they can use them in estimating answers. Facility in estimation is crucial in determining the reasonableness of answers obtained by using a calculator or computer.

This strand also focuses on developing an understanding of the commutative, associative and distributive properties as well as the unique effect of 0 and 1. These properties enhance students' understanding of the operations and are essential in mental calculations.

Measurement

The measurement strand focuses on developing an understanding of time, temperature, money, length, area, volume, capacity and mass. Emphasis is placed on estimating prior to measuring. As the students estimate and then measure to check how close their estimate is, they deepen their understanding of the measurement process.

The successive stages in the measurement process for length, area, volume, capacity and mass include:

- making comparisons between objects
- comparing an object with a non-standard unit
- comparing an object with a standard unit
- choosing measurement units for specific tasks.

Geometry

The geometry strand focuses on developing an understanding of the attributes of geometric shapes and spatial relationships. This strand builds on the students' intuitive concepts of geometric forms, moving from the concrete to the abstract. Students study three-dimensional solids and two-dimensional figures through moving, sorting, classifying, constructing and describing. Thus motion geometry, rather than geometry based on definition, is emphasized in the elementary school program.

Data Management

The data management strand focuses on developing an understanding of probability and statistics, which includes graphing. Students explore the concepts of chance as they participate in probability experiments. In statistics students collect, organize, display and interpret data in a variety of ways. Students learn how to use numbers to describe and interpret the world around them and to solve problems.

SUMMARY OF LETTER CODES FOR EACH STRAND

Each letter that is associated with a number in each strand refers to a particular conceptual understanding for that strand. These understandings and their corresponding letters are listed below for each strand.

Numeration

a. patterns, including multiples and odd and even numbers
b. sets
e. meaning of numbers, reading and writing numbers
f. ordering
h. relationship among place values, including regrouping
i. identification and naming of place value
L. meaning of fractions
m. expanded notation
n. converting fractions to decimals and vice versa (tenths, hundredths, thousandths, etc.)
o. rounding
p. equivalent fractions, including converting common fractions to decimals
q. meaning of ratios including percent
r. equivalent ratios
s. comparing fractions
t. estimation of quantity
u. number sense
v. equivalent decimals

Operations and Properties

a. processes of addition, subtraction, multiplication and division
b. symbols for the four operations
c. one-digit number facts
d. properties: commutative, associative and distributive
e. estimating and computing sums and differences of whole numbers
h. related number sentences
i. estimating and computing products of whole numbers
k. multiplication by 10, 100 and 1000
L. application of operations in solving problems
n. estimating and computing quotients of whole numbers
o. estimating and computing products of decimals
p. estimating and computing quotients of decimals
q. terminology: addend, sum, difference, factor, product, divisor, dividend and quotient
r. estimating and computing sums and differences of decimals
s. factors
u. appreciation of estimating
v. using the calculator

Measurement

a. time
c. length
d. capacity
e. mass
f. choosing appropriate measuring instruments
g. money
h. temperature
i. perimeter
j. area
k. volume
L. metric prefixes
m. angles
n. application of measurement in solving problems

Note: If the letter codes remain in the final document, then the sequence of letters for each strand will be reviewed to ensure that there are no gaps and that the ordering of the concepts is correct.

Geometry

a. classification of three-dimensional objects
b. classification of two-dimensional objects
c. geometric patterns
d. symmetry
e. construction
f. motion geometry (translations, reflections and rotations)
h. terminology
i. essential attributes of geometric figures and solids

Data Management

a. collecting data
b. organizing and displaying data
c. interpreting displayed data
d. probability concepts

ECS

Problem Solving

1. Demonstrates understanding of a problem-solving situation.
2. Demonstrates willingness to find a solution to a problem.
3. Perseveres in finding a solution to a problem.
4. Uses a variety of strategies to solve problems.
5. Presents ideas clearly.
6. Works independently or in a group.

The following strategies should be developed throughout the various strands of the program and within the problem-solving framework:

Understanding the problem
- **understands oral words and phrases**
- **knows the question asked**

Developing and carrying out a plan
- **looks for and continues simple patterns**
- **acts it out**
- **uses manipulatives and trial-and-error**

Looking back
- **states the solution to the problem**
- **determines if the answer is reasonable**

Numeration

1a. Acquires awareness of patterns by using action and manipulatives:
- **identifies patterns**
- **creates patterns**
- **reproduces a simple pattern**
- **extends a simple pattern.**

2b. Demonstrates understanding of the idea of a set by sorting objects according to attributes and describing these attributes.

3b. Matches members of two sets of manipulatives and describes the relationships using the terms: more than, less than and the same as (no written symbols).

4e. Acquires awareness of numbers (0–9) by:
- **counting a set of objects**
- **associating written numerals with sets of objects or pictures and reading these numerals**
- **making sets of objects to represent given spoken or written numerals.**

5f. Orders sets of objects to nine.

6L. Acquires awareness of the fraction concept of halves as representing part of a region by using manipulatives.

Operations and Properties

Acquires awareness of the processes of addition and subtraction through role playing and the use of manipulatives in a problem-solving setting.

Measurement

1a. Acquires awareness of terms denoting the passage of time (e.g., before, after, long time, short time, yesterday, today and tomorrow).

2c. Sequences two or more objects according to length, height and thickness.

3d. Compares the quantity in two identical containers as more than, less than or the same as.

4e. Compares two objects as heavier than, lighter than, or the same as.

5h. Compares two or more objects as hotter than, colder than or the same as and sequences according to temperature.

6c/d/e. Acquires awareness of using non-standard units of measurement.

7g. Acquires awareness of the concept of exchange in relation to purchasing.

8n. Applies measurement concepts in solving real-life problems.

Geometry

1h. Understands the spatial relationships: inside, outside, in front of, behind, between, under, over, above, below, on and near.

2a. Classifies three-dimensional objects from the physical world.

3c. Identifies, creates, reproduces and extends simple patterns using three-dimensional objects and two-dimensional figures.

Data Management

1a. Collects first-hand data (teacher guided):
- counts objects
- conducts polls
- conducts experiments.

2b. Organizes and displays data (teacher guided):
- creates classifications for data collected (starts with two categories, then extends to more than two categories)
- constructs concrete graphs using one-to-one correspondence.

3c. Interprets displayed data:
- discusses data, using the terms: more, less, and the same as.

GRADE 1

Problem Solving

1. Demonstrates understanding of a problem-solving situation.
2. Demonstrates willingness to find a solution to a problem.
3. Perseveres in finding a solution to a problem.
4. Uses a variety of strategies to solve problems.
5. Presents ideas clearly.
6. Works independently or in a group.

The following strategies should be developed throughout the various strands of the program and within the problem-solving framework:

Understanding the problem
- understands words and phrases
- knows the question asked
- interprets pictures and diagrams
- identifies given information

Developing and carrying out a plan
- looks for and continues patterns
- acts it out
- uses manipulatives and trial-and-error
- collects and uses data (concrete graphs and pictographs)
- uses pictures and diagrams

Looking back
- states the solution to the problem
- determines if the answer is reasonable
- discusses the solution process with others

Numeration

1a. Demonstrates understanding of patterns by:
  - identifying and creating patterns
  - reproducing and extending a pattern
  - translating a pattern into a different form (medium)
  - comparing the similarities and differences of patterns.

2b. Matches members of two sets of manipulatives or pictures and describes the relationships using the terms: more than, less than, greater than, fewer, and equal to (no written symbols).

3u. Understands number relationships (0–10) through exploring the arrangements and combinations of sets of objects.

4h. Groups a set of objects (up to 100) into groups of 10 and names the number in the set.

5e. Demonstrates understanding of numbers (0–100) by:
- reading and writing the numerals shown by manipulatives and diagrams
- using manipulatives or diagrams to represent spoken and written numerals.

6f. Demonstrates understanding of ordering numbers (0–10) by:
- ordering sets of objects or diagrams and connecting spoken and written numerals to the sets
- ordering spoken and written numerals and using objects and diagrams to show that the order is correct.

7L. Demonstrates understanding of fractions (halves and quarters with a numerator of one) as representing part of a region by:
- reading fractions shown by manipulatives and diagrams
- using manipulatives or diagrams to represent spoken fractions.

8t. Estimates the number of objects (0–100), counts them and compares the result to the estimate.

Operations and Properties

1a. Demonstrates understanding of the processes of addition and subtraction (taking away, missing addend and comparison) by using manipulatives and diagrams in a problem-solving setting.

2a. Acquires awareness of the processes of multiplication (repeated addition of equal groups) and division (repeated subtraction of equal groups and partitive division—equal sharing) through role playing and the use of manipulatives in a problem-solving setting.

3d. Acquires awareness of the commutative property of addition (concrete and pictorial).

4b. Symbolizes addition and subtraction situations.

5c. Understands and solves addition and subtraction facts to 10.

6c. Understands and recalls adding and subtracting 0 and 1 without hesitation (limit to 10).

7L. Applies and practises addition and subtraction in a problem-solving setting.

Measurement

1a. Understands and uses the terms related to time concepts: before, after, long time, short time, yesterday, today and tomorrow.

2a. Understands that time is divided into parts, some of which are longer or shorter than others, and that labels are applied (e.g., seconds, minutes, hours, days, weeks, months and years).

3d. Compares the capacity of any two containers as containing more than, less than or the same as.

4e. Compares two objects as heavier than, lighter than or the same as by using a balance scale.

5c/d/e. Estimates and measures length, capacity and mass by using non-standard units.

6c. Compares and sequences objects according to height, length and thickness by using non-standard units of measurement.

7f. **Acquires awareness of instruments used for measuring length, capacity, mass, time and temperature.**

8h. **Examines two or more Celsius thermometers and compares temperatures as hotter than or colder than.**

9g. **Recognizes pennies, nickels, dimes, quarters, and the dollar coin and states the value of each.**

10n. **Applies measurement concepts in solving real-life problems.**

Geometry

1h. Understands the spatial relationships, using the terms: inside, outside, in front of, behind, between, under, over, above, below, on and near.

2a. Classifies three-dimensional objects from the physical world according to various attributes and explains the classifications.

3b. Classifies and names two-dimensional figures as circles, squares, triangles and rectangles by using:
- objects from the physical world
- diagrams that include a wide variety of sizes, shapes and orientations of each type
- sets that include non-examples such as ovals and figures that contain more than four sides.

4c. Identifies, creates, reproduces, extends and compares patterns using three-dimensional objects and two-dimensional figures.

5d. **Acquires awareness of symmetry.**

Data Management

1a. Collects first-hand data:
- counts objects
- conducts polls
- conducts experiments
- **uses measuring devices (non-standard units).**

2b. Organizes and displays data:
- creates classifications for data collected (starts with two categories, then extends to more than two categories)
- constructs concrete graphs and pictographs using one-to-one correspondence.

3c. Interprets displayed data:
- discusses data, using the terms: more, less, the same as, **most, least** and **altogether.**

4d. **Acquires awareness of the chance component of probability, using the terms: always, never, sometimes and maybe.**

GRADE 2

Problem Solving

1. Demonstrates understanding of a problem-solving situation.

2. Demonstrates willingness to find a solution to a problem.

3. Perseveres in finding a solution to a problem.

4. Uses a variety of strategies to solve problems.

5. Presents ideas clearly.

6. Works independently or in a group situation.

The following strategies should be developed throughout the various strands of the program and within the problem-solving framework:

Understanding the problem
- understands words and phrases
- knows the question asked
- interprets pictures and diagrams
- identifies given information

Developing and carrying out a plan
- looks for and continues patterns
- acts it out
- uses manipulatives and trial-and-error
- uses pictures and diagrams
- collects and uses data (tally, concrete graphs and pictographs)
- chooses and carries out the appropriate operation using an appropriate method (pencil-and-paper, mental calculation, or calculator).

Looking back
- states the solution to the problem
- determines if the answer is reasonable
- discusses the solution process with others

Numeration

1. Maintains previously developed skills (identifies, creates, reproduces, extends, translates, and compares patterns).

2u. Understands number relationships (0–100) through exploring the arrangements and combinations of sets of objects.

3h. Demonstrates understanding of the relationship among place values (1's, 10's, 100's), including regrouping, by connecting:
- **spoken and written symbols to manipulatives and diagrams**
- **manipulatives and diagrams to spoken and written symbols.**

4i. **Identifies and names the place value of digits (0–999) by connecting concrete, pictorial and symbolic representations.**

5e. Demonstrates understanding of numbers (**0–999**) by:
- reading and writing the numerals shown by manipulatives and diagrams
- using manipulatives or diagrams to represent spoken and written numerals.

6f. Demonstrates understanding of ordering numbers and recognizes **"betweenness"** (**0–100**) by:
- ordering sets of objects or diagrams and connecting spoken and written numerals to the sets
- ordering spoken and written numerals and using objects and diagrams to show that the order is correct.

7g. **Names and uses ordinals first to tenth.**

8a. **Acquires awareness of the characteristics of odd and even numbers by using manipulatives and a calculator (0–100).**

9a. **Identifies multiples by counting by 2's, 5's, 10's and 100's by using manipulatives, diagrams, symbols and the calculator.**

10L. Demonstrates understanding of **proper** fractions (halves, **thirds** and quarters) as representing part of a region or **part** of a set by:
- reading and **writing** the fractions shown by manipulatives and diagrams
- using manipulatives or diagrams to represent spoken and **written** fractions.

11t. Estimates the number of objects (**0–500**).

Operations and Properties

1a. **Demonstrates understanding** of the processes multiplication (repeated addition of equal groups) and division (repeated substraction of equal groups and partitive division—equal sharing) by using manipulatives in a problem-solving setting.

2d. **Understands and uses** the commutative property of addition through discussion associated with manipulatives and diagrams.

3c. Understands and **recalls** addition and subtraction facts to 10 without **hesitation.**

4c. **Understands and solves addition and subtraction facts to 18, using appropriate strategies.**

5e. **Estimates sums and differences (sums and minuends to 99) in a meaningful context.**

6e. **Adds and subtracts (sums and minuends to 99) with and without regrouping in a problem-solving setting by:**
- **using manipulatives and diagrams to develop a pencil-and-paper method**
- **verifying a pencil-and-paper solution through the use of manipulatives and diagrams.**

7L. **Applies and practises addition and subtraction in a problem-solving setting by using mental calculation, a pencil-and-paper method or a calculator where appropriate.**

Measurement

1a. **Reads and writes time to the hour, half hour and quarter hour using standard notation.**

2h. **Reads the Celsius thermometer to five-degree intervals.**

3. Maintains previously developed skills (estimates and measures length, capacity and mass by using non-standard units; acquires awareness of appropriate measuring instruments for a given task).

4c. **Estimates and measures length by using standard units with correct symbols (cm and m).**

5c. Compares the height, length and thickness of objects by **using standard units of measurement (cm and m).**

6d. Compares **two or more** containers as containing more than, less than or the same as **by using non-standard units of measure.**

7e. Compares **two or more** objects as heavier than, lighter than or the same as **by using non-standard units of measure** on a balance scale.

8g. **Counts a collection of coins up to 25 cents.**

9g. **Gives equivalent value of coins up to 25 cents.**

10g. **Makes purchases up to 25 cents.**

11n. **Applies measurement concepts in solving real-life problems.**

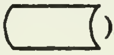
Geometry

1. Maintains previously developed skills (works with patterns of three-dimensional objects and two-dimensional figures, uses appropriate terms to describe spatial relationships).

2a. **Relates objects in the physical world to models of spheres, cylinders, cones, prisms and pyramids.**

3b. Classifies and names two-dimensional figures as circles, squares, triangles and rectangles **by tracing the faces of three-dimensional objects.**

4b. Identifies circles, squares, triangles and rectangles from a set of **any** two-dimensional figures which may have **one or more curves**

(e.g.,  **).**

5h. **Explores the vertices, edges and faces on three-dimensional objects and the sides and corners of two-dimensional figures.**

6d. **Understands and demonstrates symmetry through folding and cutting.**

Data Management

1a. Collects first-hand data:
  - counts objects
  - conducts polls
  - conducts experiments
  - uses measuring devices (**standard units – metres and centimetres, as well as** non-standard units).

2b. Organizes and displays data:
  - creates classifications for data collected
  - **uses tallies**
  - constructs concrete graphs, pictographs **and bar graphs** using one-to-one correspondence.

3c. Interprets displayed data:
  - discusses data, using the terms: more, less, the same as, most, least, altogether, **how many more and how many less.**

4d. **Understands** the chance component of probability, using the terms: always, never, sometimes, maybe, **probably, likely, unlikely, more likely and less likely.**

GRADE 3

Problem Solving

1. Demonstrates understanding of a problem-solving situation.

2. Demonstrates willingness to find a solution to a problem.

3. Perseveres in finding a solution to a problem.

4. Uses a variety of strategies to solve problems.

5. Presents ideas clearly.

6. Works independently or in a group situation.

The following strategies should be developed throughout the various strands of the program and within the problem-solving framework:

Understanding the problem
- understands words and phrases
- knows the question asked
- interprets pictures and diagrams
- identifies given information
- **restates the problem in own words**

Developing and carrying out a plan
- looks for and continues patterns
- acts it out
- uses manipulatives
- uses pictures and diagrams
- collects and uses data (tally, pictographs and **bar graphs**)
- chooses and carries out the appropriate operation using an appropriate method (pencil-and-paper, mental calculation, or calculator)
- **guesses and checks**
- **uses tables or lists**
- **checks the steps in doing the strategy**

Looking back
- states the solution to the problem
- determines if the answer is reasonable
- discusses the solution process with others
- **retells the problem with the solution**
- **looks for other ways to solve the problem**

Numeration

1. Maintains previously developed skills (identifies, creates, reproduces, extends, translates, and compares patterns; understands number relationships).

2h. Demonstrates understanding of the relationship among place values (**tenths to thousands**), including regrouping, by connecting:
- spoken and written symbols to manipulatives and diagrams
- manipulatives and diagrams to spoken and written symbols.

3i. Identifies and names the place value of digits (**0.1–9999**) by connecting concrete, pictorial and symbolic representations.

4e. Demonstrates understanding of numbers (**0.1–9999**) by:
- reading and writing the numerals and number words shown by manipulatives and diagrams
- using manipulatives or diagrams to represent spoken and written numerals and number words.

5m. **Writes numbers in expanded notation (0–1000) and vice versa and connects these symbols to concrete and pictorial representations.**

6f. Demonstrates understanding of ordering numbers and recognizes "betweenness" (0–1000) **and demonstrates understanding of symbols >, < and =** by:
- ordering sets of objects or diagrams and connecting spoken and written numerals to the sets
- ordering spoken and written numerals and using objects and diagrams to show that the order is correct.

7a. Acquires awareness of the characteristics of odd and even numbers by using manipulatives and a calculator **(0–1000)**.

8a. Identifies multiples by counting by 2's, 5's, 10's, 25's, and 100's by using manipulatives, diagrams, symbols and the calculator.

9L. Demonstrates understanding of proper fractions (halves, thirds, quarters, **fifths and tenths**) as representing part of a region or part of a set by:
- reading and writing the fractions shown by manipulatives and diagrams
- using manipulatives or diagrams to represent spoken and written fractions.

10n. **Expresses tenths as fractions and decimals.**

11t. Estimates the number of objects (**0–1000**).

Operations and Properties

1a. Understands the processes of multiplication (repeated addition of equal groups) and division (repeated substraction of equal groups and partitive division—equal sharing) by using manipulatives and diagrams in a problem-solving setting.

2a. **Identifies addition, subtraction, multiplication and division situations (concrete, pictorial and symbolic).**

3e. Estimates sums and differences of any two- or three-digit numbers by using the front-end method in a meaningful context.

4e. Adds and subtracts **any two- or three-digit numbers** by:
- using manipulatives and diagrams to develop a pencil-and-paper method
- verifying a pencil-and-paper solution through the use of manipulatives and diagrams.

5b. **Symbolizes multiplication and division situations**

(e.g., 3×8, $\begin{array}{r}8\\ \underline{\times 3}\end{array}$, $24\div 3$, $3\overline{)24}$).

6d. Understands and uses the commutative property of addition and multiplication through discussion associated with manipulatives and diagrams.

7h. Understands the relationship between addition and subtraction in a problem-solving setting by connecting manipulatives, diagrams and related number sentences.

8h. Understands the relationship between multiplication and division in a problem-solving setting by connecting manipulatives, diagrams and related number sentences.

9d. Understands the unique effect of 0 and 1 in addition and multiplication by using manipulatives and diagrams in a problem-solving setting.

10c. Understands and recalls addition and subtraction facts to 18 without hesitation.

11c. Understands and solves multiplication and division facts to 45, using appropriate strategies.

12k. Understands the multiplication of whole numbers by 10 and 100.

13L. Applies and practises addition, subtraction, multiplication and division in a problem-solving setting by using mental calculation, a pencil-and-paper method or a calculator where appropriate.

Measurement

1a. Reads and writes time to the nearest hour, half hour, quarter hour and five-minute intervals using standard notation.

2h. Reads the Celsius thermometer to one degree intervals and uses the symbol (°C).

3c. Estimates and measures length by using standard units with the correct symbols (cm, m, dm, km).

4d/e. Estimates and measures capacity and mass by using standard units with correct symbols (L, kg).

5c/d/e. Compares the length, capacity and mass of objects by using standard units of measurement (cm, m, dm, km L and kg).

6g. Counts collections and gives equivalent value of coins up to $1.00.

7g. Makes purchases and change up to $1.00.

8n. Applies measurement concepts in solving real-life problems.

Geometry

1. Maintains previously developed skills with circles, squares, triangles, and rectangles (classification in relation to the name of the figure, patterning).

2e. Constructs three-dimensional objects (prisms, cylinders and spheres).

3a. Classifies and names three-dimensional objects: cylinders, spheres, pyramids, cones and prisms.

4e. Constructs two-dimensional figures (3, 4, 5, 6 and 8 sides).

5i. Describes the essential attributes of circles, squares, triangles and rectangles.

6h. Understands and uses the terms: vertex, edge, face, side and corner.

7c. Identifies symmetric figures and draws lines of symmetry on two-dimensional figures.

Data Management

1a. Collects data:
   a) First-hand information
      - counts objects
      - conducts polls
      - conducts experiments
      - uses measuring devices (m, cm, **dm, km, L, kg**).

   b) **Second-hand information**
      - **extracts data from given sources such as tables, lists, visuals, and printed resources.**

2b. Organizes and displays data:
   - creates classifications for data collected
   - uses tallies
   - **uses rank ordering**
   - constructs pictographs and bar graphs using correspondence of 1 to 1, **2 to 1, 5 to 1, and 10 to 1**
   - **locates the position of an object on a grid by referring to columns and rows.**

3c. Interprets displayed data:
   - discusses data, using appropriate terms
   - **uses data in solving problems.**

4d. Develops probability concepts through experiments:
   - **understands the chance component of probability, using the terms: always, never, sometimes, maybe, probably, likely, unlikely, more likely and less likely**
   - **identifies impossible events, certain events and uncertain events**
   - **understands that the results of probability experiments are not influenced by the knowledge, experience, age or skill of the experimenter.**

GRADE 4

Problem Solving

1. Demonstrates understanding of a problem-solving situation.

2. Demonstrates willingness to find a solution to a problem.

3. Perseveres in finding a solution to a problem.

4. Uses a variety of strategies to solve problems.

5. Presents ideas clearly.

6. Works independently or in a group situation.

The following strategies should be developed throughout the various strands of the program and within the problem-solving framework:

Understanding the problem
- understands words and phrases
- knows the question asked
- interprets pictures and diagrams
- identifies given information
- restates the problem in own words
- knows what information is needed
- knows what information is missing

Developing and carrying out a plan
- looks for and continues patterns
- acts it out
- uses manipulatives
- uses pictures and diagrams
- collects and uses data (tally, pictographs and bar graphs)
- chooses and carries out the appropriate operation using an appropriate method (pencil-and-paper, mental calculation, or calculator)
- guesses and checks
- uses tables or lists
- checks the steps in doing the strategy

Looking back
- states the solution to the problem
- determines if the answer is reasonable
- discusses the solution process with others
- retells the problem with the solution
- looks for other ways to solve the problem
- considers other possible solutions to the problem

Numeration

1. Maintains previously developed skills (identifies, creates, reproduces, extends, translates, and compares patterns; understands number relationships; counts by 2's, 5's, 10's, 25's and 100's; acquires awareness of odd and even numbers; estimates the number of objects).

2h. Demonstrates understanding of the relationship among place values (from **hundredths to ten thousands**), including regrouping, by connecting:
- spoken and written symbols to manipulatives and diagrams
- manipulatives and diagrams to spoken and written symbols.

3i. Identifies and names the place value of digits (**0.01–99 999**) by connecting concrete, pictorial and symbolic representations, where appropriate.

4v. **Uses manipulatives and diagrams to construct equivalent decimals (tenths and hundredths) and connects these representations to appropriate spoken and written symbols.**

5e/f. Reads, writes and orders whole numbers and decimals (**0.01–99 999**) by connecting concrete, pictorial and symbolic representations, where appropriate.

6m. Writes numbers in expanded notation and vice versa (**0–99 999**).

7o. Demonstrates understanding of rounding whole numbers (**limit: to nearest thousand**) by connecting concrete, pictorial and symbolic representations.

8L. Demonstrates understanding of proper fractions (emphasis on halves, thirds, quarters, fifths, tenths and **hundredths**) as representing a **point on a number line**, part of a region or part of a set by:
- reading and writing the fractions shown by manipulatives and diagrams
- using manipulatives or diagrams to represent spoken and written fractions.

9n. Expresses tenths and hundredths as fractions and decimals.

10p. **Uses manipulatives and diagrams to construct equivalent fractions (emphasis on halves, quarters, fifths, tenths and hundredths) and connects these representations to the appropriate spoken and written symbols in a problem-solving setting.**

11s. **Uses manipulatives and diagrams to compare proper fractions.**

Operations and Properties

1e. Estimates sums and differences (limit: **four-digit numbers**) by using rounding, front-end method and **compensation** in a meaningful context.

2e. Adds and subtracts (limit: **four-digit numbers**) by:
- using manipulatives and diagrams to develop a pencil-and-paper method
- verifying a pencil-and-paper solution through the use of manipulatives and diagrams.

2i. **Estimates products of two- and three-digit whole numbers and one-digit multipliers by using rounding in meaningful context.**

3i. Multiplies two- and three-digit whole numbers by one-digit whole numbers by:
- using manipulatives and diagrams to develop a pencil-and-paper method
- verifying a pencil-and-paper solution through the use of manipulatives and diagrams.

4h. Writes related sentences for addition and subtraction; multiplication and division and verifies by using manipulatives and diagrams.

5d. Understands and uses the commutative and associative property of addition and multiplication through discussion associated with manipulatives and diagrams.

6d. Understands and uses the distributive property concrete and pictorially (e.g., 4 × 8 can be found by adding 4 fives and 4 threes).

7c. Understands and recalls addition and subtraction facts to 18 and multiplication and division facts to 81 without hesitation.

8n. Estimates quotients of two-digit whole numbers and one-digit divisors by using compatible numbers and compensation in a meaningful context.

9n. Divides two-digit whole numbers by a one-digit divisor (with and without remainders) by:
- using manipulatives and diagrams to develop a pencil-and-paper method
- verifying a pencil-and-paper solution through the use of manipulatives and diagrams.

10k. Understands the multiplication of whole numbers by 10, 100 and 1000.

11r. Estimates sums and differences of decimals to hundredths by using rounding, front-end method and compensation in a meaningful context.

12r. Adds and subtracts decimals to hundredths by:
- using manipulatives and diagrams to develop a pencil-and-paper method
- verifying a pencil-and-paper solution through the use of manipulatives and diagrams.

13v. Adds, subtracts, multiplies and divides using the calculator and uses the constant feature for these operations.

14L. Applies and practises addition, subtraction, multiplication and division in a problem-solving setting by using mental calculation, a pencil-and-paper method or a calculator where appropriate.

Measurement

1a. Reads and writes time to minutes using standard notation.

2h. Reads Celsius thermometer, and determines reasonableness of reading to given situations.

3c/d/e. Estimates and measures length, capacity and mass by using standard units and correct symbols (mm, cm, dm, km, mL, L, g, kg).

4c/d/e. Uses appropriate standard measuring units for length, capacity and mass.

5c/d/e. Compares the length, capacity and mass of objects by using standard units of measurement (mm, cm, m, dm, mL, L, g and kg).

6g. Uses money (bills and coins, including the dollar coin) for purchasing and making change.

7n. Applies measurement concepts in solving real-life problems.

Geometry

1. Maintains previously developed skills (classifies and constructs two-dimensional figures and three-dimensional objects; names and describes the essential attributes of circles, squares, triangles and rectangles; names three-dimensional objects; understands and uses the terms: vertex, edge, face, side and corner; identifies symmetric figures and draws lines of symmetry).

2e. Constructs three-dimensional objects (prisms, cylinders , spheres, **cones** and **pyramids).**

3a/b. Classifies three-dimensional objects and two-dimensional figures by:
- **naming** the three-dimensional objects as prisms or pyramids **given** the objects or the **nets**
- **naming the faces on the prisms and pyramids given the objects or the nets.**

4f. **Translates (slides) and reflects (flips) two-dimensional figures by using manipulatives.**

Data Management

1a. Collects data:
   a) first-hand information
   - counts objects
   - conducts polls
   - conducts experiments
   - uses measuring devices (**mm**, m, cm, dm, km, **mL**, L, **g**, kg).

   b) Second-hand information
   - extracts data from given sources such as tables, lists, visuals, and printed resources.

2b. Organizes and displays data:
- creates classifications for data collected
- uses tallies
- uses frequency distributions including class intervals where appropriate
- uses rank ordering
- constructs pictographs and bar graphs using correspondence of 1 to 1, 2 to 1, 5 to 1, **10 to 1, 50 to 1 and 100 to 1**
- **locates the position of a point on a grid by using ordered pairs**
- **writes the coordinates of a point on a grid as an ordered pair.**

3c. Interprets displayed data:
- discusses data, using appropriate terms
- uses data in solving problems.

4d. Develops probability concepts through experiments:
- understands the chance component of probability, using the terms: always, never, sometimes, maybe, probably, likely, unlikely, more likely and less likely
- identifies impossible events, certain events , uncertain events, **equally likely events and unequally likely events (limit of two events)**
- understands that the results of probability experiments are not influenced by the knowledge, experience, age or skill of the experimenter.

GRADE 5

Problem Solving

1. Demonstrates understanding of a problem-solving situation.
2. Demonstrates willingness to find a solution to a problem.
3. Perseveres in finding a solution to a problem.
4. Uses a variety of strategies to solve problems.
5. Presents ideas clearly.
6. Works independently or in a group situation.

The following strategies should be developed throughout the various strands of the program and within the problem-solving framework:

Understanding the problem
- understands words and phrases
- knows the question asked
- interprets pictures and diagrams
- identifies given information
- restates the problem in own words
- knows what information is needed
- knows what information is missing
- knows what information is extraneous

Developing and carrying out a plan
- looks for and continues patterns
- acts it out
- uses manipulatives
- uses pictures and diagrams
- collects and uses data (tally, pictographs , bar graphs and line graphs)
- chooses and carries out the appropriate operation using an appropriate method (pencil-and-paper, mental calculation, or calculator)
- guesses and checks
- uses tables or lists
- does a simpler but related problem
- checks the steps in doing the strategy

Looking back
- states the solution to the problem
- determines if the answer is reasonable
- discusses the solution process with others
- retells the problem with the solution
- looks for other ways to solve the problem
- considers other possible solutions to the problem
- does similar problems
- alters the problem and finds the effect

Numeration

1. Maintains previously developed skills (identifies, creates, reproduces, extends, translates and compares patterns; understands number relationships; counts by 2's, 5's, 10's, 25's and 100's; acquires awareness of odd and even numbers, estimates the number of objects).

2h. Demonstrates understanding of the relationship among place values (from **thousandths to hundred thousands**), including regrouping, by connecting:
- spoken and written symbols to manipulatives and diagrams
- manipulatives and diagrams to spoken and written symbols.

3i. Identifies and names the place value of digits (**0.001–999 999**) by connecting concrete, pictorial and symbolic representations, where appropriate.

4v. Demonstrates understanding of equivalent decimals (tenths, hundredths and **thousandths**) by:
- reading and writing the equivalent decimals shown by manipulatives and diagrams
- **generating equivalent decimals in symbolic form and verifying their equivalence using manipulatives and diagrams.**

5e/f. Reads, writes and orders whole numbers and decimals (**0.001–999 999**) by connecting concrete, pictorial and symbolic representations, where appropriate.

6m. Writes numbers in expanded notation and vice versa (**0–999 999**).

7o. Demonstrates understanding of rounding whole numbers (**limit: to the nearest ten thousand**) and **decimals (tenths and hundredths)** by connecting concrete, pictorial and symbolic representations.

8n. Expresses tenths, hundredths and **thousandths** as fractions and decimals.

9L. Demonstrates understanding of proper fractions, **improper fractions and mixed numbers** (emphasis on halves, thirds, quarters, fifths, tenths and hundredths) in relation to number lines, regions or sets by:
- reading and writing the fractions and mixed numbers shown by manipulatives and diagrams
- using manipulatives or diagrams to represent spoken or written fractions and mixed numbers.

10L. **Uses manipulatives and diagrams to relate mixed numbers to improper fractions and connects these representations to the appropriate spoken and written symbols.**

11p. **Generates** equivalent fractions (emphasis on halves, quarters, fifths, tenths and hundredths) by **using written and spoken symbols in a problem-solving setting**, and **verifies their equivalence by using manipulatives and diagrams.**

12s. Uses manipulatives and diagrams to compare fractions including proper fractions, **improper fractions and mixed numbers** (emphasis on halves, thirds, quarters, fifths and tenths).

Operations and Properties

1. Maintains previously developed skills with whole numbers (estimates sums and differences; adds and subtracts; masters one-digit number facts; understands and uses the commutative and associative properties of addition and multiplication and the distributive property).

2i/n. Estimates products of whole numbers (**limit: three-digit multipliers**) by using rounding and compensation in a meaningful context.

3i. Multiplies whole numbers using one- and two-digit multipliers by:
- using manipulatives and diagrams to develop a pencil-and-paper method
- verifying a pencil-and-paper solution through the use of manipulatives and diagrams, where appropriate.

4n. Estimates quotients of two-, three- and four-digit whole numbers and one-digit divisors by using compatible numbers and compensation in a meaningful context.

5i. Divides two-, three- and four-digit whole numbers using one-digit divisors by:
- using manipulatives and diagrams to develop a pencil-and-paper method
- verifying a pencil-and-paper solution through the use of manipulatives and diagrams.

6k. Understands the multiplication of whole numbers and decimals by 10, 100 and 1000.

7. Maintains previously developed skills in estimating sums and differences of decimals.

8r. Adds and subtracts decimals to thousandths by:
- using manipulatives and diagrams to develop a pencil-and-paper method
- verifying a pencil-and-paper solution through the use of manipulatives and diagrams.

9q. Understands and uses the terms: sum, difference, factor, product, divisor, dividend and quotient.

10s. Understands and identifies factors of whole numbers by using manipulatives and diagrams.

11v. Maintains previously developed skills with the calculator (performs the four basic operations, uses the constant feature of the calculator).

12v. Understands and uses the memory feature of the calculator.

13L. Applies and practises addition, subtraction, multiplication and division in a problem-solving setting by using mental calculation, a pencil-and-paper method or a calculator where appropriate.

Measurement

1a. Reads and writes time to seconds using standard notation.

2a. Reads the 24-hour clock.

3. Maintains previously developed skills (estimates, measures and compares using standard units of length, capacity and mass; reads the Celsius thermometer; purchases and makes change).

4e. Extends estimation and measurement of mass to include tonne and its correct symbol (t).

5c. Expresses equivalent linear measures by using manipulatives, where appropriate (limit: km, m, dm, cm, mm).

6i. Finds and compares the perimeter of polygons by using manipulatives and diagrams (no formulas) in a problem-solving setting.

7j. Finds and compares the area of rectangles by using manipulatives and diagrams (no formula) in a problem-solving setting.

8i/j. Demonstrates understanding of the relationship between perimeter and area by using manipulatives and diagrams to make rectangles:
- having the same perimeter but different areas
- having the same area but different perimeters.

9n. Applies measurement concepts in solving real-life problems.

Geometry

1. Maintains previously developed skills (classifies, constructs and names two-dimensional figures and three-dimensional objects; describes the essential attributes of circles, squares, triangles and rectangles; understands and uses the terms: vertex, edge, face, side and corner; identifies symmetric figures and draws lines of symmetry; translates and reflects two-dimensional figures).

2b. Classifies and names two-dimensional figures as circles, triangles, squares, rectangles, **pentagons, hexagons and octagons.**

3i. **Describes the essential attributes of prisms, pyramids, cones, cylinders and spheres.**

4a/b. Classifies three-dimensional objects and two-dimensional figures by:
- **naming prisms and pyramids according to the types of bases** given the objects or nets (e.g., triangular prism)
- naming **cylinders** and **cones** given the objects or **nets.**

5f. **Identifies and draws** translations (slides) and reflections (flips) of two-dimensional figures.

6f. **Rotates (turns) two-dimensional figures by using manipulatives.**

7h. **Understands and uses the terms: line segment, line, ray and angle.**

Data Management

1a. Collects data:
- a) First-hand information
  - counts objects
  - conducts polls
  - conducts experiments
  - uses measuring devices (mm, m, cm, dm, km, mL, L, g, kg).
- b) Second-hand information
  - extracts data from both given and researched sources such as tables, lists, visuals, and printed resources.
- c) **Recognizes the difference between first-hand data and second-hand data.**

2b. Organizes and displays data:
- creates classifications for data collected
- uses tallies
- **draws tree diagrams**
- uses frequency distributions including class intervals where appropriate
- uses rank ordering
- constructs pictographs and bar graphs using correspondence of 1 to 1, 2 to 1, 5 to 1, 10 to 1, 50 to 1, 100 to 1 and 1000 to 1
- locates the position of a point on a grid by using ordered pairs
- writes the coordinates of a point on a gird as an ordered pair
- **constructs line graphs**
- **distinguishes among the types of graphs and discusses reasons for using each type of graph.**

3c. Interprets displayed data:
- discusses data, using appropriate terms
- uses data in solving problems.

4d. Develops probability concepts through experiments:
- understands the chance component of probability, using the terms: always, never, sometimes, maybe, probably, likely, unlikely, more likely and less likely
- identifies impossible events, certain events, uncertain events, equally likely events and unequally likely events **(two or more events)**
- understands that the results of probability experiments are not influenced by the knowledge, experience, age or skill of the experimenter.
- **predicts the results of probability experiments**
- **compares two probability experiments with common events and identifies which experiment would more likely yield a specified event (e.g., choosing a yellow bead from two different sets of yellow and blue beads).**

GRADE 6

Problem Solving

1. Demonstrates understanding of a problem-solving situation.
2. Demonstrates willingness to find a solution to a problem.
3. Perseveres in finding a solution to a problem.
4. Uses a variety of strategies to solve problems.
5. Presents ideas clearly.
6. Works independently or in a group situation.

The following strategies should be developed throughout the various strands of the program and within the problem-solving framework:

Understanding the problem

- understands words and phrases
- knows the question asked
- interprets pictures and diagrams
- identifies given information
- restates the problem in own words
- knows what information is needed
- knows what information is missing
- knows what information is extraneous

Developing and carrying out a plan

- looks for and continues patterns
- acts it out
- uses manipulatives
- uses pictures and diagrams
- collects and uses data (tally, pictographs , bar graphs, **double bar graphs** and line graphs)
- chooses and carries out the appropriate operation using an appropriate method (pencil-and-paper, mental calculation, or calculator)
- guesses and checks
- uses tables or lists
- does a simpler but related problem
- **uses logical reasoning**
- checks the steps in doing the strategy

Looking back

- states the solution to the problem
- determines if the answer is reasonable
- discusses the solution process with others
- retells the problem with the solution
- looks for other ways to solve the problem
- considers other possible solutions to the problem.
- does similar problems
- alters the problem and finds the effect
- generalizes the solution

Numeration

1. Maintains previously developed skills (identifies, creates, reproduces, extends, translates and compares patterns; understands number relationships; counts by 2's, 5's, 10's, 25's and 100's; acquires awareness of odd and even numbers; estimates the number of objects).

2h. Understands the relationship among place values (from ten thousandths to billions), including regrouping.

3i. Identifies and names the place value of digits (0.000 1–1 000 000 000).

4e/f. Reads, writes and orders whole numbers and decimals (0.000 1–1 000 000 000).

5m. Writes decimal numerals using expanded notation (limit to ten thousandths).

6o. Understands rounding numbers (0.000 1–1 000 000 000).

7. Maintains previously developed skills in understanding equivalent fractions and decimals and in understanding, reading, writing and comparing fractions (proper fractions, improper fractions and mixed numbers).

8n. Expresses tenths, hundredths, thousandths and ten thousandths as fractions and decimals.

9p. Uses manipulatives, diagrams and the calculator to express fractions (halves, quarters and fifths) as decimals and vice versa.

10q. Demonstrates understanding of ratios by:
- reading and writing the ratios (a:b, a to b, and $\frac{a}{b}$) shown by manipulatives and diagrams
- using manipulatives or diagrams to represent spoken and written ratios.

11q. Demonstrates understanding of percent as a ratio by connecting concrete, pictorial and symbolic representations.

12r. Uses manipulatives and diagrams to generate equivalent ratios and connects these representations to the appropriate spoken and written symbols in a problem-solving setting.

13s. Understands integers and their use in the real world.

14f. Demonstrates understanding of ordering integers, determines "betweenness" and demonstrates understanding of symbols >, < and = by connecting spoken and written symbols to representations on a number line.

Operations and Properties

1. Maintains previously developed skills with whole numbers (appreciates the need for estimating; estimates sums, differences, products and quotients; adds, subtracts, multiplies and divides; masters one-digit number facts; understands and uses the commutative and associative properties of addition and multiplication and the distributive property; understands terms: addend, sum, difference, factor, product, divisor, dividend and quotient).

2i/n. Estimates products of any whole numbers by using rounding, compatible numbers and compensation in a meaningful context.

3i. Divides whole numbers using one- and two-digit divisors by:
- using manipulatives and diagrams to develop a pencil-and-paper method
- verifying a pencil-and-paper solution through the use of manipulatives and diagrams, where appropriate.

4. Maintains previously developed skills with decimals (estimates sums and differences; adds and subtracts).

5o/p. Estimates products and quotients of any decimals by using rounding, compatible numbers and compensation in a meaningful context.

6o. Multiplies decimals (to thousandths) by one- and two-digit whole number multipliers by:
- **using manipulatives and diagrams to develop a pencil-and-paper method**
- **verifying a pencil-and-paper solution through the use of manipulatives and diagrams, where appropriate.**

7o. Multiplies whole numbers and decimals (to thousandths) by one- and two-digit decimal multipliers by:
- **using diagrams to develop a pencil-and-paper method**
- **verifying a pencil-and-paper solution through the use of diagrams, where appropriate.**

8p. Divides decimals (to thousandths) by one- and two-digit whole number divisors by:
- **using manipulatives and diagrams to develop a pencil-and-paper method**
- **verifying a pencil-and-paper solution through the use of manipulatives and diagrams, where appropriate.**

9p. Divides whole numbers and decimals by one-digit decimal divisors by:
- **using manipulatives and diagrams to develop a pencil-and-paper method**
- **verifying a pencil-and-paper solution through the use of manipulatives and diagrams, where appropriate.**

10h. Understands the relationship between multiplication and division by using multiplication to check division and vice versa.

11. Maintains previously developed skills with the calculator (performs the four basic operations, uses the constant and memory features of the calculator, understands the appropriate use of the calculator).

12L. Applies and practises addition, subtraction, multiplication and division in a problem-solving setting by using mental calculation, a pencil-and-paper method or a calculator where appropriate.

Measurement

1a. Reads the 24-hour clock and writes corresponding time notation.

2. Maintains previously developed skills (reads and writes time; estimates, measures and compares using standard units of length, capacity and mass; finds perimeter of polygons and area of rectangles by using manipulatives and diagrams; relates perimeter to area).

3L. Understands and uses the system of metric prefixes including the use of symbols: kilo (k), hecto (h), deca (da), BASIC UNIT, deci (d), centi (c), milli (m).

4c. Expresses linear measure to the nearest tenth and hundredth of a metre by using manipulatives, where appropriate.

5c. Expresses linear measures in expanded form by using manipulatives, where appropriate.

6c/d/e. Expresses equivalent measures within all units of length, capacity and mass.

7a. Expresses equivalent measures of time.

8j. Finds and compares the area of **triangles** and rectangles by using manipulatives and diagrams (no formulas) in a problem-solving setting.

9k. Finds and compares the volume of rectangular solids by using manipulatives and diagrams (no formulas) in a problem-solving setting.

10k. Explores the relationship between the volume and the dimensions of rectangular solids by constructing rectangular solids that have the same volume but different dimensions.

11m. Estimates the measure of an angle. Measures and constructs angles by using a protractor.

12n. Applies measurement concepts in solving real-life problems.

Geometry

1. Maintains previously developed skills (classifies, constructs, names and describes the essential characteristics of two-dimensional figures and three-dimensional objects; identifies symmetric figures and draws lines of symmetry; translates, reflects and rotates two-dimensional figures; understands and uses the terms: vertex, edge, face, side, corner, line segment, line, ray and angle).

2h. **Understands and uses the terms for angles (acute, right, obtuse, straight and reflex).**

3h. **Understands and uses the terms intersecting and parallel lines.**

4e. **Identifies and constructs radius, diameter and circumference.**

5f. **Identifies** and **draws** translations (slides), reflections (flips) and **rotations (turns).**

Data Management

1a. Collects data:
  a) First-hand information
    - counts objects
    - conducts polls
    - conducts experiments
    - uses measuring devices (mm, m, cm, dm, km, mL, L, g, kg).
    - **designs and uses questionnaires in conducting a poll.**

  b) Second-hand information
    - extracts data from both given and research sources such as tables, lists, visuals, and printed resources.

  c) Recognizes the difference between first-hand data and second-hand data.

2b. Organizes and displays data:
- creates classifications for data collected
- uses tallies
- draws tree diagrams
- uses frequency distributions
- uses rank ordering
- constructs pictographs and **double** bar graphs using correspondence of 1 to 1, 2 to 1, 5 to 1, 10 to 1, 50 to 1, 100 to 1 and 1000 to 1
- locates the position of points in all **four quadrants** by using ordered pairs
- writes the coordinates of a point in any **of the four quadrants** as an ordered pair
- constructs line graphs
- distinguishes among the types of graphs and discusses reasons for using each type of graph.

3c. Interprets displayed data:
- discusses data (including **circle graphs**), using appropriate terms
- uses data in solving problems.

4d. Develops probability concepts through experiments:

- understands the chance component of probability, using the terms: always, never, sometimes, maybe, probably, likely, unlikely, more likely and less likely
- identifies impossible events, certain events , uncertain events, equally likely events and unequally likely events (two or more events)
- understands that the results of probability experiments are not influenced by the knowledge, experience, age or skill of the experimenter.
- predicts the results of probability experiments
- compares two probability experiments with common events and identifies which experiment would more likely yield a specified event (e.g., choosing a yellow bead from two different sets of yellow and blue beads).
- identifies all the possible outcomes of a probability experiment
- uses a fraction to describe the probability of an event
- understands and uses the term odds.

MATHEMATICS (ECS – GRADE 6)

ALTERNATIVE HORIZONTAL FORMAT SAMPLE

→ Solid lines indicate mastery of concept

···→ Dotted lines indicate maintenance of concept

NUMERATION

N-1. Demonstrates understanding of patterns by:

- identifying patterns.
- creating patterns.
- reproducing patterns.
- extending patterns.
- translating a pattern into a different form (medium).
- comparing the similarities and differences of patterns.

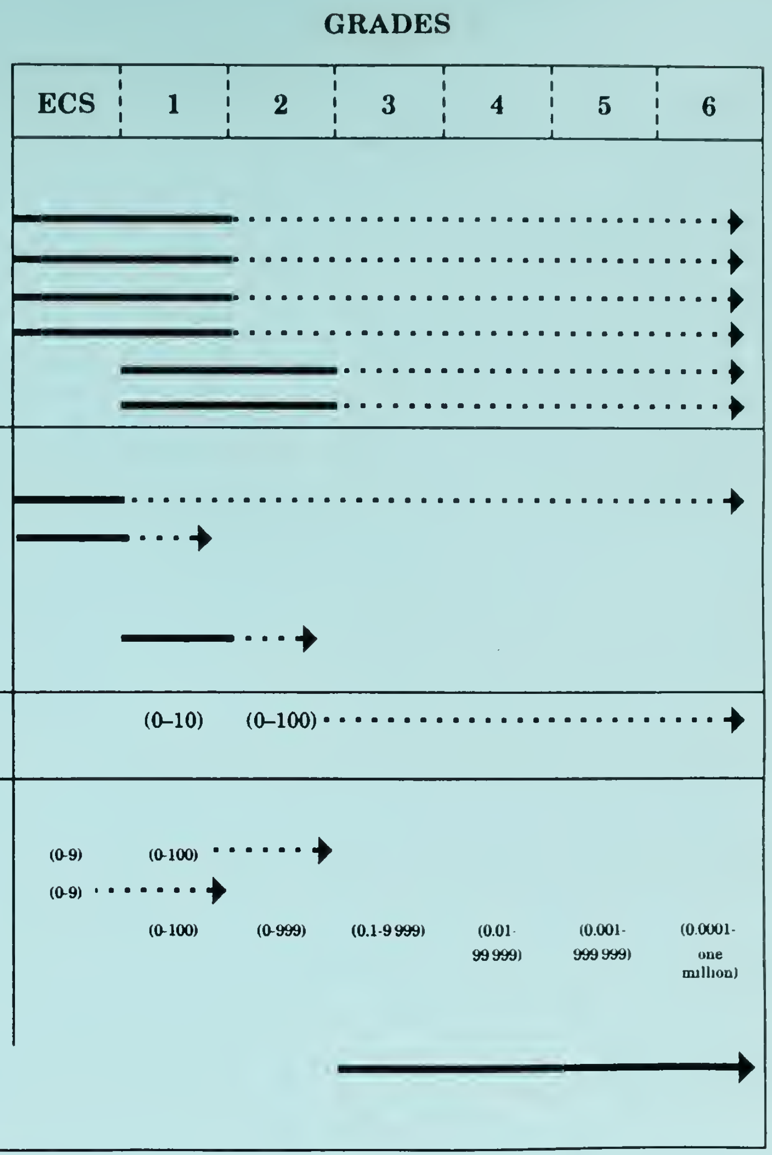
N-2. Demonstrates understanding of sets by:

- sorting objects according to attributes and describing these attributes.
- matching members of two sets of manipulatives and describing the relationships using the terms: more than, less than and the same as (no written symbols).
- matching two sets of pictures and describing the relationships using the terms: greater than, fewer and equal to (no written symbols).

N-3. Demonstrates understanding of number relationships through exploring the arrangements and combinations of sets of objects.

N-4. Demonstrates understanding of numbers by:

- counting a set of objects.
- associating a numeral with a set of objects or pictures.
- reading and writing the numerals shown by manipulatives and diagrams, where appropriate.
- using manipulatives or drawing diagrams to represent spoken and written numerals, where appropriate.
- writing number words and connecting them with manipulatives and diagrams, where appropriate.



OPERATIONS AND PROPERTIES

Addition and Subtraction of Whole Numbers

	GRADES						
	ECS	1	2	3	4	5	6
O-1. Acquires awareness of the processes of addition and subtraction through role playing and the use of manipulatives in a problem-solving setting.	→						
O-2. Demonstrates understanding of the processes of addition and subtraction (taking away, missing addend and comparison) by using manipulatives and diagrams in a problem-solving setting.		━	━	━	━	━	→
O-3. Symbolizes addition and subtraction situations.		━	━	━	━	━	→
O-4. Estimates sums and differences (sums and minuends to 99) in a meaningful context.			→				
O-5. Adds and subtracts (sums and minuends to 99) with and without regrouping in a problem-solving setting by: • using manipulatives and diagrams to develop a pencil-and-paper method • verifying a pencil-and-paper method through the use of manipulatives and diagrams.			→				
O-6. Estimates sums and differences of any two- or three-digit numbers by using the front-end method in a meaningful context.				→			
O-7. Adds and subtracts any two- or three-digit numbers by: • using manipulatives and diagrams to develop a pencil-and-paper method • verifying a pencil-and-paper method through the use of manipulatives and diagrams.				→			
O-8. Estimates sums and differences (limit: four-digit numbers) by using rounding, front-end method and compensation in a meaningful context.					━	·····	·····→
O-9. Adds and subtracts (limit: four-digit numbers) by: • using manipulatives and diagrams to develop a pencil-and-paper method • verifying a pencil-and-paper method through the use of manipulatives and diagrams.					━	·····	·····→

OPERATIONS AND PROPERTIES

	GRADES						
	ECS	1	2	3	4	5	6
One-Digit Number Facts							
O-10. Acquires awareness of the strategies useful for solving addition and subtraction facts.		→					
O-11. Understands and solves addition and subtraction facts to 10.		→					
O-12. Understands and recalls adding and subtracting 0 and 1 without hesitation (limit to 10).		→					
O-13. Understands and recalls addition and subtraction facts to 10 without hesitation.			━	⋯	⋯	⋯	⋯→
O-14. Understands and solves addition and subtraction facts to 18, using appropriate strategies.			→				
O-15. Understands and recalls addition and subtraction facts to 18 without hesitation.				━	⋯	⋯	⋯→
O-16. Understands and solves multiplication and division facts to 45.				→			
O-17. Understands and recalls multiplication and division facts to 81 without hesitation.					━	⋯	⋯→

DATA MANAGEMENT

	GRADES						
	ECS	1	2	3	4	5	6
Probability							
Develops probability concepts through experiments:				━	━	━	━→
D-1. Understands the chance components of probability, using the terms:							
• always, never, sometimes, maybe,		━	━	···	···	···	···→
• probably, likely, unlikely, more likely and less likely			━	···	···	···	···→
D-2. Identifies:							
• impossible events, certain events, uncertain events				━	···	···	···→
• equally likely events and unequally likely events							
– limit of two events					━→		
– two or more events						━	···→
D-3. Understands that the results of probability experiments are not influenced by the knowledge , experience, age or skill of the experimenter.				━	···	···	···→
D-4. Predicts the results of probability experiments.						━	···→
D-5. Compares two probability experiments with common events and identifies which experiment would more likely yield a specified event (e.g., choosing a yellow bead from two different sets of yellow and blue beads).						━	···→
D-6. Identifies all the possible outcomes of a probability experiment.							━→
D-7. Uses a fraction to describe the probability of an event.							━→
D-8. Understands and uses the term odds.							━→

Alberta
EDUCATION

MATHEMATICS COMPONENT OF THE PROGRAM OF STUDIES FOR ELEMENTARY SCHOOLS

RESPONSE GUIDE

BACKGROUND

NOTE: Identification is not necessary, but would be appreciated. An acknowledgement will be forwarded to all those who include their name and address.

1. Name: ____________________

School (if applicable): ____________________

Jurisdiction/Organization: ____________________

Address: ____________________

____

____

This response is:

☐ a personal response

☐ a school staff response

____ number involved in preparation

☐ a jurisdiction response

____ number involved in preparation

☐ other
please specify ____________________

If this is a personal response, please indicate your major teaching assignment. If it is a school or jurisdiction response please indicate grades covered.

ECS ____

Grades 1 – 3 ____

Grades 4 – 6 ____

Grades 1 – 6 ____

ECS – Grade 6 ____

Please forward to:

Susan Lynch, Assistant Director (ECS/Elementary)
Curriculum Design Branch
Alberta Education
11160 Jasper Avenue
Edmonton, Alberta
T5K 0L2

* **To be included in the review and revision process, responses should be returned on or before Friday, March 22, 1991.**

The primary purpose of the *Program of Studies for Elementary Schools* is to set out the goals for students' learning. Further expansion and definition of key terms and concepts, as well as strategies for planning, instruction, evaluation and using resources are found in other documents, such as guides, monographs and teacher resource manuals.

This response guide is in two parts.
Part I asks you to provide written comments on the key sections of the proposed mathematics component of the *Program of Studies for Elementary Schools.* It also asks you to provide suggestions for a teacher resource manual.
Part II asks you to indicate your level of agreement with a series of statements related to the proposed program and to indicate your preference for format.

PART I

Please comment on each of these sections. (Your comments may be questions related to ideas that need to be clarified.)

A. Rationale and Philosophy

B. General Learner Expectation

C. Specific Learner Expectations
Layout and Presentation: please indicate with a check (✓) the format you prefer and explain why.

( ) • organization by grade (white pages)

( ) • alternative horizontal format sample that shows concept development from ECS to Grade 6 (blue pages)

continued

Content: please comment on each section. Indicate the grade and use reference numbers when referring to particular SLEs.

- Problem Solving

- Numeration

- Operations and Properties

- Measurement

- Geometry

continued

- Data Management

Please answer these questions related to a teacher resource manual.

E. Which ideas and terms used in the proposed program should be explained in a teacher resource manual?

F. What would you want included in a teacher resource manual to help you to implement the proposed concepts, skills and attitudes?

G. Additional comments.

PART II

A. Please indicate with a check (✓) your level of agreement with the following statements:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. The Rationale and Philosophy statements describe current thinking about children's mathematics learning.	___	___	___	___	___
2. The Rationale and Philosophy statements and accompanying diagram effectively explain the process of abstracting (constructing) and applying mathematical concepts.	___	___	___	___	___
3. The General Learner Expectation provides an overview of the main ideas related to children's mathematics learning.	___	___	___	___	___
4. The diagram and related statements in the fourth critical dimension of the General Learner Expectation (pages B.1 and B.2) effectively explain the development of students' conceptual understanding in mathematics.	___	___	___	___	___
5. The Specific Learner Expectations describe effectively a continuum of children's mathematics development from ECS to Grade 6.	___	___	___	___	___
6. In most cases, the Specific Learner Expectations are appropriate to the grade levels they cover. (NOTE: Please indicate specific problems in Part I.)	___	___	___	___	___
7. The Specific Learner Expectations include most of the important aspects of children's mathematics learning. (NOTE: Please indicate omissions in Part I.)	___	___	___	___	___
8. In general, the Rationale and Philosophy, the General and Specific Learner Expectations are clearly and consistently linked.	___	___	___	___	___
9. In general, the mathematics component of the *Program of Studies for Elementary Schools* will help teachers to plan for their students' mathematics development.	___	___	___	___	___
10. The overall emphasis in the Rationale and Philosophy and the General and Specific Learner Expectations is the development of students' understanding of mathematical concepts.	___	___	___	___	___

continued

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
11. The emphasis on the use of manipulatives in the document is needed in promoting students' understanding of mathematical concepts.	___	___	___	___	___
12. Problem solving is emphasized and integrated throughout the document.	___	___	___	___	___

B. Please indicate with a check (✓) the format for the Specific Learner Expectations you prefer:

- organization by grade (white pages) ☐
- alternative horizontal format sample that shows concept development from ECS to Grade 6 (blue pages) ☐

For office use only ☐ ☐ ☐ ☐

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